FINAL ADJUNCT LESSONS LEARNED TECHNICAL REPORT

EXECUTIVE SUMMARY

Generic MANPRINT Analysis
Adjunct Lessons Learned
Technical Reports on MPT
in Army MANPRINT Analyses
(GM/ALLTR)
(Delivery Order Number 0031)

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EXECUTIVE SUMMARY

The study, "Generic MANPRINT Analysis Adjunct Lessons Learned Technical Reports on MPT in Army MANPRINT Analyses (GM/ALLTR)," was conducted during the period August 1990 through November 1991. The purpose of the effort, as stated in the study plan prepared by the Army, was:

> With a purview up to and including MILESTONE I, this study will be used to identify key agencies conducting Manpower, Personnel, and Training (MPT) analyses for the Army, to evaluate analysis deliverables, and to assess and enhance the tools used for conducting MPT analyses. It will identify obstacles to meaningful use of those study efforts (to include such things as timing problems, certification procedures, and the like), and recommend a systemic remedy to whatever difficulties are found in the course of the study; and identify and consolidate the MPT analysis tools currently used (as well as enhancements effected by the study) into a MANPRINT Analysis Aid.

Coincident with the study, the Department of Defense instituted a new systems acquisition program, promulgated in the following documents:

- DODD 5000.1, Defense Acquisition (23 Feb 91)
- DODI 5000.2, Defense Acquisition Management Policies and Procedures (23 Feb 91)
- DOD 5000.2-M, Defense Acquisition Management Documentation and Reports (23 Feb 91)

In examining MANPRINT MPT analysis as it was actually being conducted, the study of necessity reflected the policies and procedures in effect before the adoption of the new acquisition system. Recommendations were formulated in the context of the new system.

Seven Study Objectives were set forth in the Study Plan. The results for each of them are summarized in the following paragraphs.

OBJECTIVE 1. Identify MPT analyses required for input to Army acquisition decisions and concept formulation.

Requirements were identified from three types of sources - documented requirements, findings from interviews of MANPRINT and acquisition system practitioners, and interpretation of the intent of the Army MANPRINT program.

The relationships found to exist among acquisition considerations relevant to manpower, personnel, and training are depicted at Figure 1. Those relationships define the scope of MPT analysis requirements. A particular system design concept

MANPOWER, PERSONNEL, AND TRAINING RELATIONSHIPS

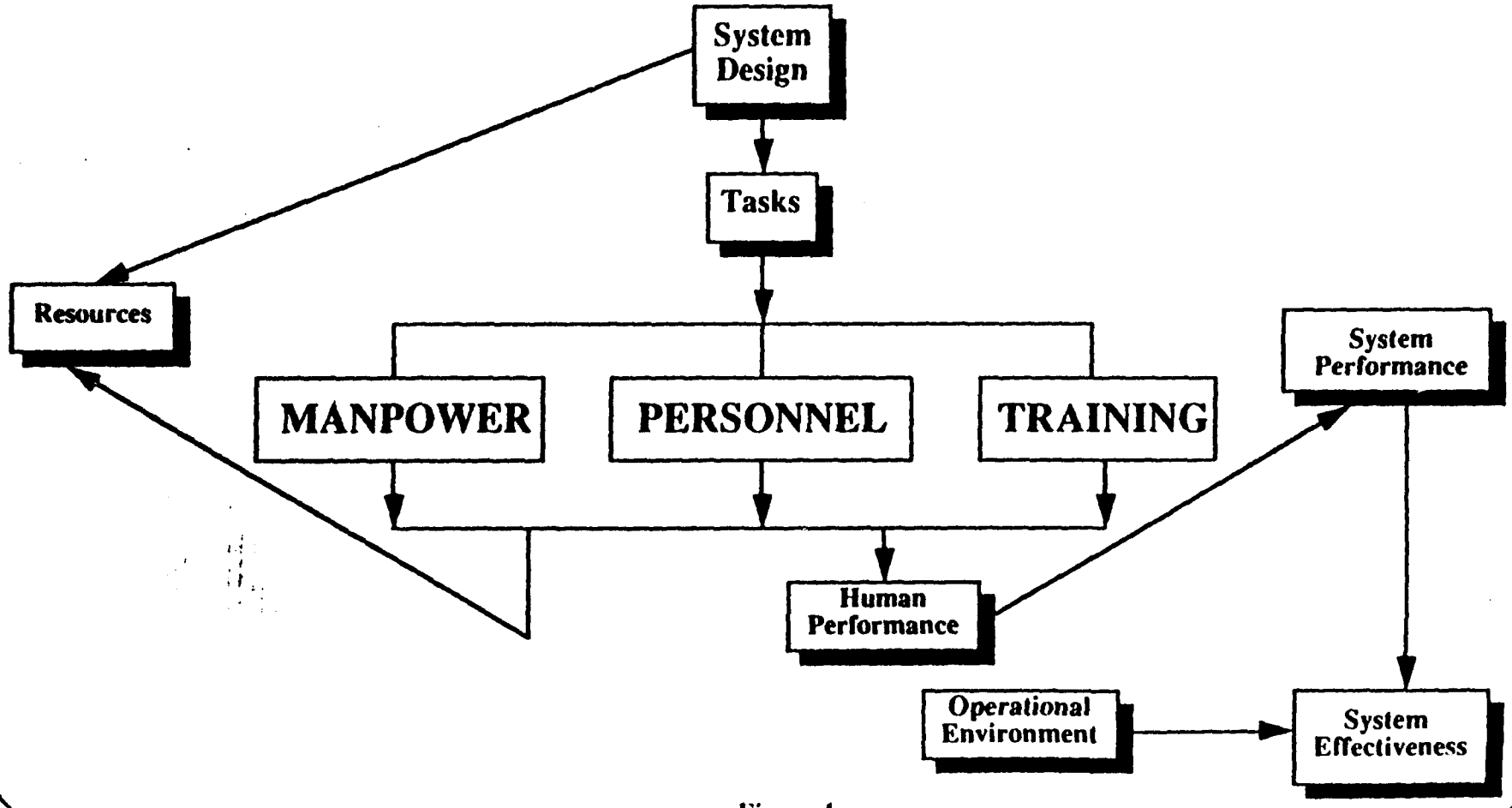

Figure 1

determines the human tasks which are required to operate, maintain, and provide logistical support to the system. The tasks in turn drive the requirements for quantitative manning, required characteristics and innate abilities of personnel, and needed training. Human performance is the product of the interactions of tasks with manpower, personnel, and training. The combination of human performance with the system design, in terms, for example, of lethality, mobility, vulnerability, reliability, maintainability, and availability, drives system performance. System effectiveness on the battlefield is a combination of individual system performance and the total battlefield environment, including friendly and enemy forces, operational concepts, and support.

Total life cycle resources attributable to a particular system concept depend on the system design (e.g., research, development, testing, procurement, replacement parts) and the resources required for manpower, personnel, and training.

Results of MPT analyses encompassing all of the relationships shown in Figure 1 are required by acquisition documents for Milestone I. Annex B to Appendix 3 of the main Final Report (designated Appendix H for the Analysis Aid) contains a detailed listing of the requirements for ten required program documents under the new acquisition system. As an example, the Cost and Operational Effectiveness Analysis (COEA) alone encompasses all the relationships shown in Figure 1. Similar results are also required for the Operational Requirements Document (ORD).

OBJECTIVE 2. Identify MPT tools used, available, and needed to conduct MPT analyses.

Twenty-two tools directly applicable to MPT analyses through Milestone I were identified. Of the sixteen currently available, thirteen were developed for application to Army systems, and three for the Air Force. One of the Air Force models is directly applicable to Army use; the other three would require modification. Six models are under development or testing and will be available in the near term, within five years. Four of these are applicable to the Army and two to the Air Force.

Most of the current Army models have been used in specialized MPT analyses, but only two have been widely applied. These are HARDMAN (Hardware versus Manpower), along with its automated derivatives, and ECA (Early Comparability Analysis). HARDMAN uses comparability methodology to derive resource requirements for conceptual systems; it addresses system performance only indirectly and incompletely. ECA examines predecessor and/or reference systems to derive lessons learned for application to a comparable developmental system. It does not directly estimate either effectiveness or resource requirements for the developmental system.

None of the existing models alone addresses all the MPT analysis requirements identified under Objective 1. HARDMAN comes closest, but is

unsatisfactory for examination of system performance and personnel characteristics. The near-term model HARDMAN III is intended to examine all the elements shown in Figure 1 except the relationships between individual system performance and operational system effectiveness; combat simulations are required for the operational analysis. HARDMAN III is currently undergoing testing and, presuming successful validation, should be available in calendar year 1992. Two of its six components (SPARC (System Performance and RAM Criterion Development Aid) and MAN-SEVAL (Manpower-Based System Evaluation Aid)) are already available.

Needed MPT research and new models are addressed under Objective 7.

OBJECTIVE 3. Detail a process by which MPT analyses may be performed most efficiently and effectively to meet present and future Army decision requirements (to include funding, prioritizing, scheduling, and interfacing with Army Modernization Plans).

The recommended MPT analysis process addresses the following elements:

- Analysis requirements and criteria
- Analysis planning and tailoring
- Organization for analysis
- Assistance, oversight, and quality control

Each are summarized briefly below:

Analysis requirements and criteria. Recommended baseline content and criteria for precision of MPT analysis results were derived from the findings under Objective 1.

Content:

- Quantitative manpower requirements
- Identification of operator, maintainer, and supply support MOS
- Personnel characteristics, in dimensions used in Army selection and testing
- Training resource requirements corresponding to postulated training strategies
- System performance and availability parameters

- Resource availabilities compared to estimated requirements
- MPT goals and constraints
- Recommended resolution of MPT resource problems

Criteria for precision:

- System analysis to sub-system level, e.g., engine, fire control
- Operator and maintainer tasks to the duty level, e.g., target acquisition, transmission removal
- Comparability analysis techniques acceptable
- Subject Matter Expert input acceptable as data
- Simple deterministic modeling acceptable
- Assumptions and data consistent across all analysis products

Recommendations for formulation and use of acquisition phase exit criteria are presented in the Final Report.

Analysis Planning and Tailoring. An MPT Analysis Plan is recommended as an integral part of the System MANPRINT Management Plan. The following planning elements are recommended:

- Adherence to regulatory requirements. Implementation of the baseline requirements and criteria previously presented will satisfy requirements as of the time of this study.
- Issue development. The plan should establish mechanisms to ensure that MPT issues relevant to the acquisition program are identified and addressed.
- Analysis integration, throughout all acquisition program processes and documentation.
- Analysis methodology selection and/or development.
- Plans for review and approval of analyses.

Recommend that MPT analysis efforts be tailored for each acquisition program. Factors to be included in the tailoring process were identified as follows:

- Potential impacts of the system, which are determined by the projected number of systems to be fielded, the degree of technological change presented to system operators and maintainers, and possible changes in supply support requirements.

- Importance of the system to the Army, considering its impact on future force capabilities, its acquisition category and cost, and the degree of visibility or controversy associated with the system.

- Experience with previous similar systems, including any problems in manning, personnel acquisition and retention, training, system performance, and system readiness.

Organization for analysis. A dedicated, qualified MPT analyst is recommended for each TRADOC school. The presence of RAM engineers at the schools was found to be effective and efficient. MPT analysis and its contribution to the MANPRINT program is considered to be at least as complex and important as the RAM program, requiring (and deserving) as much support. The MPT analyst could conduct small scale MPT analyses and assist in large scale, comprehensive ones.

Centralized conduct of large scale analyses is recommended, primarily because of efficiency and limitations on Army analytical manpower. These could be conducted by the Army in-house or by a contractor. If conducted in-house, a centralized MPT analysis activity at TRADOC level is recommended. If conducted by a contractor, centralized funding and prioritization is recommended. Funding should allow for a significant, but not necessarily full-time, on-site contractor presence at the supported school.

The conduct of large scale MPT analyses in conjunction with the COEA was found to be feasible. The scope and timing of the COEA would have to be modified to meet all MPT analysis requirements.

Assistance, oversight, and quality control. Quality control of contracted MPT analyses conducted under the aegis of the MANPRINT program is currently exercised by Technical Advisory Groups (TAGs) assembled by the TRADOC school being supported. The analytical capabilities of TAG members has varied considerably. As a result, the control of analysis quality in many instances has depended on the quality of the contractor and on the contract-level oversight provided by the Deputy Chief of Staff for Personnel Integration of the U.S. Army Total Army Personnel Command (TAPC-PI), formerly the U.S. Army Personnel Integration Command (USAPIC). Quality control of other, MPT-related analyses has been exercised by the organizations involved, e.g., TRADOC Analysis Command (TRAC) for COEAs, and the Combined Arms Support Command (CASCOM) for RAM analyses. TRAC has also provided quality control of selected analyses conducted by TRADOC schools. Times for review and approval range from 30 days

for MANPRINT MPT analyses to more than three months for complex analyses with an MPT content.

Establishment of a TRADOC-level assistance, oversight, and quality control activity is recommended. With participation throughout the conduct of analyses, study approval within 30 days of completion would be possible with no loss of quality compared to the current processes.

Army Modernization Plans. Advanced Technology Transition Demonstrations (ATTDs) and Advanced Systems and Concepts Offices (ASCOs) are discussed in Appendix C to the Final Report. Recommendations regarding MPT analysis interfaces are contained in Section 9 of the report.

OBJECTIVE 4. Set out recommendations on how Army analysts and/or action officers may be efficiently trained to conduct or manage necessary MPT analyses with considerations given to future limitations in manpower, training, and other resources.

The need for MPT analyst training depends on the organizational concepts adopted by the Army. If MPT analyses are to be conducted solely by contractors, no training programs will be required. If analyses are conducted in-house, training will be necessary. Assuming that Army analysts will conduct full-scale MPT analyses, an 80-hour training course is recommended. Although clearly inadequate for attainment of expertise in all facets of MPT analysis, the recommended training course would provide a basis for officers and civilians with underlying analytical skills to gain needed expertise through self-study and experience. Major topics for the course are:

- Introduction to MANPRINT MPT Analysis - 2 hours
- Army Organization and Operations - 10 hours
- Analysis Techniques - 56 hours
- Data Acquisition and Evaluation - 10 hours
- Examination and Critique - 2 hours

Six hours additional training in analytical techniques is recommended for action officer training in the existing MANPRINT Action Officer Course (MAOC).

OBJECTIVE 5. Evaluate and recommend quality control procedures for expeditiously evaluating contracted and in-house MPT analyses within the Army.

For purposes of continuity, results pertaining to Objective 5 were presented under Objective 3.

OBJECTIVE 6. Provide a basis for evaluating the cost effectiveness of existing MPT analysis tools (and those projected to be available within the next five years) by identifying the historical or projected cost of using each.

Estimated costs of applying the twenty-two tools identified as directly applicable to MPT analyses were obtained. For the two tools with widespread use, HARDMAN and ECA, actual average costs are reported; for others, Army and Air Force points of contact were consulted. A large difference was noted between the observed resources required for the existing HARDMAN and the projected costs for HARDMAN III. The existing HARDMAN, with automated assistance, has required more than 5700 analyst hours for the full scale analysis of a complex system, while the combination of HARDMAN III and MANCAP II is estimated by the points of contact to require just over 600 hours. Some of the difference can be attributed to the inclusion in HARDMAN III of data files containing maintenance data for a number of existing systems along with manpower and personnel data. Nevertheless, it is emphasized that as much as 75% of the time required for a full scale MPT analysis is independent of the kinds of data handling and computations performed by a model. Actual resource requirements for HARDMAN III cannot be finally determined until it is employed for full-scale analyses of systems in the pre-Milestone I phase of development. It is also emphasized that, within limits, resource requirements depend more on the desired content and precision of an analysis than the tool chosen for use.

OBJECTIVE 7. Provide a template for research on, and use of, MPT tools with a view to planning MPT research and development.

Additional research and tool development were found to be needed in the following areas:

- MPT constraint determination, for application to the MNS, ORD, Requests for Proposals, and development contracts.
- Manpower requirements estimation, in the representation of relationships between individual task performance and workloads.
- Military Occupational Specialty (MOS) and job structuring, with consideration of all relevant MPT and system design variables.
- Expansion of the treatment of task performance beyond existing dimensions of speed and "go/no-go" accuracy, with consideration of both basic soldier attributes and training.
- Representation of the relationships among individual task performance, group/crew level performance, system performance, and operational effectiveness.

- Relatively simple, personal computer-based soldier-in-the loop simulations.

- Improved methods for formulating Operational Mode Summaries/Mission Profiles (OMS/MPs). Although OMS/MPs are not strictly MPT issues, virtually all MPT analyses are highly sensitive to them.

- A simple "quick-and-dirty" MPT analysis tool to facilitate rapid response answers to MPT issues. In time, HARDMAN III, with operational validation and adequate analyst training and experience, might meet that need. In the interim, a new tool is recommended.

ADDED RECOMMENDATIONS.

In the course of the study, observations not strictly associated with specific study objectives were made. These related to:

- The System MANPRINT Management Plan (SMMP)

- AR 602-2, Manpower and Personnel Integration (MANPRINT) in the Materiel Acquisition Process

- Inclusion of references to MPT tools and data bases in revised Army publications

- Timing of the Cost and Training Effectiveness Analysis (CTEA)

- The MANPRINT Practitioner's Guide

- MANPRINT Risk Assessment

- The MANPRINT Reference Retrieval Support System (MANRRS)

- Possible improvements to DOD level publications

Specific recommendations are consolidated in Section 9 of the Final Report.

ANALYSIS AID. A Manpower, Personnel, and Training (MPT) Analysis Aid was developed to assist in MANPRINT analyses in the period through Milestone I of the materiel acquisition process. It presents guidance for planning and conducting MPT analyses which adhere to the requirements of DODD 5000.1, DODI 5000.2, and DOD 5000.2-M and to the overall objectives of the Army MANPRINT program. Available MPT models are described, along with sources of data. The Aid is published as Volume 2 of the Final Report.